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Examining Human Perception of Elephants and Large Trees for Insights into Conservation of an African Savanna Ecosystem

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EXAMINING HUMAN PERCEPTION OF ELEPHANTS AND LARGE TREES FOR INSIGHTS INTO CONSERVATION OF AN AFRICAN SAVANNA ECOSYSTEM

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By

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ABSTRACT

In savanna ecosystems, African elephants (*Loxodonta africana*) and large trees such as marula (*Sclerocarya birreaand*) and knobthorn (*Acacia nigrescens*) have ecological and human value; however, elephants have a large impact on favored trees, motivating the need for ecological conservation strategies. This study examined the perceptions of tourists and residents towards elephants, large trees, and other relevant factors for management purposes. In the Associated Private Nature Reserves, South Africa, a survey was distributed to tourists and residents to determine perceptions of elephants of different age classes, group sizes and sex, and toward savanna habitat impacted to varying degrees by elephants. Both interest groups had high attractiveness rankings for all elephant types. Undamaged tree types received high attractiveness rankings while damaged trees received lower ranks, revealing a conflict of interests. Undamaged trees and the elephant types that cause high amounts of impact to those trees are both liked. Respondents may not be associating attractiveness levels with levels of impact. Residents encouraged more intrusive elephant management methods than tourists. Environmental manipulation was found to be the most supported and balanced technique. This supports the use of meta-population management, which focuses primarily on the environment and the elephant population secondarily.

Keywords: APNR, Human/wildlife Conflict, Management, Questionnaire, Tourism

In loving memory of my grandfather, Joseph Clifton Edge, who, along with my father, instilled in me a love of the outdoors for all that it can provide. I know he is looking down on me with a smile.

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CHAPTER 1

INTRODUCTION

African elephants (*Loxodonta africana*) and large trees are important to the savanna ecosystem in South Africa and to certain interest groups such as tourists and residents of the area. There are an estimated 270,299 elephants in Southern Africa (2012 Continental, 2013). Elephants can severely impact vegetation by causing trauma to woody trees (Van Wyk & Fairall, 1969) through uprooting, tree felling, and bark stripping (Chafota, 1998). Elephants such as large bulls potentially have a higher impact on vegetation than other age and sex classes (Hiscocks, 1999). The large males have a tendency to break and bite stems with larger diameters than females or sub-adult males (Greyling, 2004; Stokke & du Toit, 2000) as well as requiring larger amounts of food (Woolley, Millspaugh, van Rensburg, Page, & Slotow, 2010). Females in breeding herds have added nutritional demand for high quality diets during pregnancy or lactation suggesting a higher impact on trees as food sources (Woolley et al., 2010), and an increasing number of elephants such as that in a breeding herd is presumed to have a greater impact compared to a single individual of that herd. The effect of elephants on the vegetation plays an important role in shaping the environment.

The balance between woodlands and grasslands in the savannas is largely determined by the elephant (Moe, Rutina, Hytteborn, & du Toit, 2009). The habitat modifying behavior of elephants with their environment also has an important effect

on other species groups living in the same savanna habitat (White & Goodman, 2010). Trees are keystone structures that provide shelter and resources that are essential for other species in the environment (Tews et al., 2004). This allows for a high animal diversity (Seymour, 2010). Along with the importance of large trees in the savanna for wildlife, trees also have humanistic value, such as the cutting of large trees outside of protected areas for economic purposes like firewood and building material. This clearing of trees can yield land used for agriculture.

The tree value pertaining to the aesthetics associated with tourism is a major focus in this study. The first connection tourists make with their vacation destination is from the photos they see at home on the internet, in magazines, or in the media. These photos are most often modified by advertisers to be "perfect" depictions of the area. Therefore, tourists expect to see a natural environment comparable to the aesthetics of the modified images (Barretto, 2013). If tourists see images of a savanna landscape with perfect, healthy trees and a diversity of elephant types, for instance, that is what they anticipate upon their visit; but this image does not reflect reality. It is a common misconception that all tourists go to the South African protected areas just to view the megafuana as many are more interested in other environmental factors and scenery; although large mammals seems to be the main attraction (Lindsey, Alexander, Mills, Romanach & Woodroffe, 2009). While the non-African and inexperienced tourists may have a higher fascination for the predators and mega-herbivores, the local Africans and experienced wildlife viewers are probably more drawn to the birds and plant diversity including the large savanna trees. A large majority of the South African tourism market is made up of these local Africans and experienced eco-tourists (Lindsey et al., 2009). Therefore, carefully planned conservation strategies need to be devised to manage the ecological connection,

mentioned previously, between both elephants and large trees. This will keep a broader spectrum of tourists satisfied (Lindsey et al., 2009)

The conflict surrounding the effects of elephants on large trees within savannas is an ever growing concern not only ecologically but economically in light of the burgeoning South African tourism industry (Tourism, 2011). These management issues are occurring mainly due to the change in living styles for the people in the area over the past 100 years (Chafota, 1998). More people are now living within and around elephant habitat constricting their natural range (Osborn, 2004), and in fenced-off, well-protected areas in South Africa, elephant populations are increasing (Whyte, van Aarde, & Pimm, 2003). A multifarious amount of variables must be taken into consideration when dealing with the balancing act of human appeal and what is optimal for the environment. Elephant effects on the vegetation have been scrutinized by many residents in South Africa. The concern for various plant species was expressed by the residents of the Associated Private Nature Reserves (APNR) during a 2003 survey taken by Dr. Michelle (*Greyling*) Henley (Elephants Alive, previously Save the Elephants – South Africa) with specific concern about marula (Sclerocarya birrea), knobthorn (Acacia nigrescens), and false marula (Lannea sweinfurti) trees (Greyling, 2003). The expectations for aesthetically appealing landscapes with a particular vegetation structure and composition may be the deciding factor for which type of elephants and of what number can be in the area. This has been termed the aesthetic carrying capacity as opposed to ecological carrying capacity (Owen-Smith, Kerley, Page, Slotow, & van Aarde, 2006).

Environmental and social concerns are being studied by many conservation bodies and both need to be understood before making management decisions (Bath, 1998). Management plans are very difficult to put into effect without knowledge of

public opinion (Johnson, Johnson, Edwards & Wheaton, 1993). Many management officials have been pressured to involve stakeholders in management planning to resolve social issues (Chase, Decker & Lauber, 2010). Certain research activities as practiced within the APNR, such as the collaring of elephants or the wire-net protection of large trees (Henley 2013, Henley 2014), may be perceived by some as lowering the photo-tourism value of such destinations. Hence, it is important to understand how research-based management actions may influence tourist perceptions and attitudes. Collecting human survey data has become increasingly popular (White, Jennings, Renwick, & Barker, 2005), and rapid human dimension developments have been made to better understand human-wildlife conflict ("Human", 2013). All of those involved have a view point to be recognized.

Managers have a moral obligation to create a plan that will please all groups as much as possible within that jurisdiction (Todd, 1980). A blurred line of biological and social science has been established when it comes to wildlife management (Decker & Chase, 1997). In the case of the present study, the large scale impact that elephants of different age and sex classes (hereafter called 'types') may be affecting human perceptions of these animals. Both elephants and large trees have ecological and economic value contributing to their aesthetics. By making use of questionnaires, this study seeks to find the true aesthetic values of different elephant and vegetation types and discusses the effect those values may have on management strategies.

Given the wide array of literature that has identified residential concern of elephants as contributors to high tree impact (Greyling, 2003; Lindsay, 1993; Skarpe et al., 2004), I tested whether tourists compared to residents would give all elephant types higher attractiveness rankings in the APNR location of South Africa. In contrast, I expected the two groups to have similar perceptions of attractiveness for

tree types. Perceptions surrounding certain research-based activities (collaring elephants and wire-net protecting large trees) were expected to differ between residents and tourists with residents viewing research activities such as the gathering of data to contribute towards best-practice models while tourists might perceive such actions as a diminishing their "wilderness" experience. Demographic variables such as gender, age, lodge used for tourists, and residential category also were analyzed to inspect how different background information might be impacting attractiveness rankings.

Perceptions of elephant attractiveness may be affected by previous experiences with elephants, such as the schema-triggered effect (Fiske, 1982). .In this effect, respondents who observed elephants impacting trees or felt intimidated by their presence would give lower attractiveness rankings to the elephant types than those who have not had those experiences. Alternatively, respondents who observed elephants resting or socializing beneath large trees may rank elephants and large trees higher on an attractiveness scale than people lacking such experiences.

Most tourists visit protected areas in Africa to view large mammals, including elephants (Lindsey, Alexander, Mills, Romanach & Woodroffe, 2009), while residents often may be in conflict with such animals (Thirgood, Woodroffe, & Rabinowitz, 2005). Therefore, I hypothesized that tourists would have higher support for non-intrusive management methods while residents would have a higher support for methods requiring elephant intrusion. Tourists in all likelihood hope to see relaxed, well-fed wildlife and would oppose intrusive activity that could potentially interfere with this expectation. Residents, being concerned about elephant effects, are looking for any solutions to their "problem".

Due to the concerns about tree impact in the literature, it is presupposed that residents place great value on the trees within their area, suggesting that tourists will have higher support for the humanistic purposes of cutting trees outside of protected areas than residents. However, this may be offset by tourists having an aesthetic connection to the landscape (Barretto, 2013), thereby resulting in no overall differences between interest groups with regards to the removal of large trees for human use.

Lastly, the concern by residents over the diminished health and value of trees impacted by elephants led me to hypothesize that the attractiveness levels of elephants would be influenced by the amount of tree impact caused by specific elephant types. As elephants use trees to varying degrees, the amount of impact on specific tree types would influence the attractiveness levels of those tree types. More specifically, I stated that residents would give low impact elephants, types that are expected to have less of an impact on large trees, greater rankings than tourists. Furthermore, residents would rank high impact elephants, types that have high levels of impact on trees, lower than would tourists. Residents have the opportunity to appreciate known tree specimens found on their property over time. Consequently, residents often develop a sense of protectiveness for such trees, which could fuel negative perceptions with regards to elephant impact far more readily than for tourists. This again has a connection to the schema-triggered process stated by Fiske (1982). Both tourists and residents were hypothesized to find healthy trees attractive and damaged trees unattractive.

Because residents complain about elephants impacting trees and tourists expect a "perfect" landscape, I hypothesized a correlation between elephant type attractiveness and tree type attractiveness. Therefore, the interest group attractiveness

levels of low impact elephant types were hypothesized to have a positive correlation with non-impacted tree attractiveness levels. Conversely, high attractiveness ratings for high impact elephants should correlated positively with high scores to highly impacted trees. By extension, high ratings of low impact elephants would correlate negatively with high ratings of highly impacted trees, and high attractiveness ratings for high impact elephants would correlate negatively with high ratings for non-impacted trees. These correlations would show if respondents made a connection between the impact levels of different elephant types and tree types.

CHAPTER 2

METHODS

2.1. Study Site

This study took place in area known as the Associated Private Nature Reserves (APNR), which is adjacent to Kruger National Park (KNP). The APNR is comprised of four connecting private reserves: Balule Private Nature Reserve (BPNR), Klaserie Private Nature Reserve (KPNR), Timbivati Private Nature Reserve (TPNR), and Umbabat Private Nature Reserve (UPNR) (Fig. 1). Together, these reserves contain an area of approximately 1800 km^2 of conserved properties. The fence between the APNR and KNP was dropped in 1993, creating a connected habitat known as the greater Kruger National Park region. The human subjects who participated in the survey included the residents and managers within these private nature reserves as well as tourists that stayed at the selected lodges in the area from July to November 2012.

2.2. Questionnaire Construction

A questionnaire was constructed to gain information on human perception about African elephants, their habitat, and different factors pertaining to the relationship between elephants and their habitat, specifically with regard to large trees. This was a self-administered questionnaire that was composed of a photograph ranking system

for elephant and tree types, dichotomous "yes" or "no" questions, and short answer questions to obtain demographic information. Questionnaires were distributed to residents (landowners, shareholders, wardens, managers, and other) and tourists asking only slightly different demographic questions that may pertain to one interest group and not the other. Save the Elephants- South Africa provided photographs of elephants and vegetation that were local to the APNR area. Tourists and residents were asked to rank in order of attractiveness the appearance of seven different elephant types. Photographs were selected to provide a standardized visual image of each elephant type with the elephant(s) as the focal feature. All photographs show elephants from the right side and the photographs used were taken during the dry, winter months when the vegetation is less vibrant. The elephant types used were young bull, prime bull, mature cow, calf elephant, mature cow with her young, prime bull with a radio-collar, and a large herd of elephants. Using an attractiveness ranking scale of very low (1), low (2), average (3), high (4), very high (5) subjects were asked to select a number that best fit each elephant type according to their perception.

This same photographic ranking system was used for vegetation types in the area. Three of the most abundant tree species in the area, namely *Sclerocarya birrea* (marula), *Acacia nigrescens* (knobthorn), and *Colophospermum mopane* (mopane), were represented. Seven different vegetation types were used including a healthy marula, healthy marula with wire-netting, a broken stemmed marula with regrowth, a large marula with bark-stripping, an open area with small trees, an open area with large trees (marulas and knobthorns), and an area thick with mopane. Photographs were selected to show different levels of elephant impact, to understand the visual human perception of wire-netting on trees, and to find the attractiveness level of different landscape types in the area.

The yes or no questions were devised to understand any background information that may be influencing attractiveness levels. This information included past experiences that respondents may have had with elephants or trees such as viewing elephants impacting trees. There were also questions to obtain data on the respondents' support for particular research endeavors, elephant management methods, and the cutting of large native trees for economic purposes. Check Appendix B for sample sizes.

Short answer questions were added to the survey to obtain demographic data about each respondent. All survey-takers were asked to provide their country of origin, year of birth, and gender. Tourists were asked to state how many times per year they travel outside of their home country, how many times per year they visit South Africa for non-residents, their preferred language, and the name of their lodge. Of the tourist specific demographics only lodge of residence was analyzed due to low sample size issues with the tourist variables stated above. Residents were asked to state how many years they have been a resident of South Africa and the most appropriate residential category, which included landowners (full property owner), shareholders (partial property owner), wardens (head management officer), field guides (trained tour guide) or other (not fitting in other categories) in order to gain a perspective from residents with different backgrounds. A resident could be classified into more than one of these categories. A copy of the survey is available in the appendix.

2.3. Questionnaire Distribution

Surveys were distributed during what Safari Bookings labels as the high tourist season months of July through November in 2012. Residents of the APNR received surveys

via email by using a contact list provided by Dr. Michelle Henley. Questionnaires were emailed to residents on three separate occasions throughout the months. Completed surveys were returned via email or fax (Residents, n = 83).

For tourists, surveys were distributed to lodges within the APNR. Prospective lodges were chosen based on previous assistance in years past and their convenient location to the Elephants Alive research camp on Tanda Tula in TPNR and the Transfrontier Africa research camp located on the Olifants West section of BPNR. Managers at 10 lodges and camps agreed to assist with the distribution of questionnaires to their guests. The participating lodges from TPNR were Bateleur Eco Safaris, Kings Camp, Rock Fig, Tanda Tula Safari Camp, and Umlani Bushcamp. The participating lodges from BPNR were Campfire Safaris, Ezulwini River Lodge, Naledi Enkoveni, Toro Yaka, and Tremesana (Fig. 1). After the initial distribution of hard-copied surveys to lodges in early July contact was made with managers every two weeks to check on progress (Tourists, n = 141). See Appendix C for lodge sample sizes. Data collection was completed at the end of November 2012.

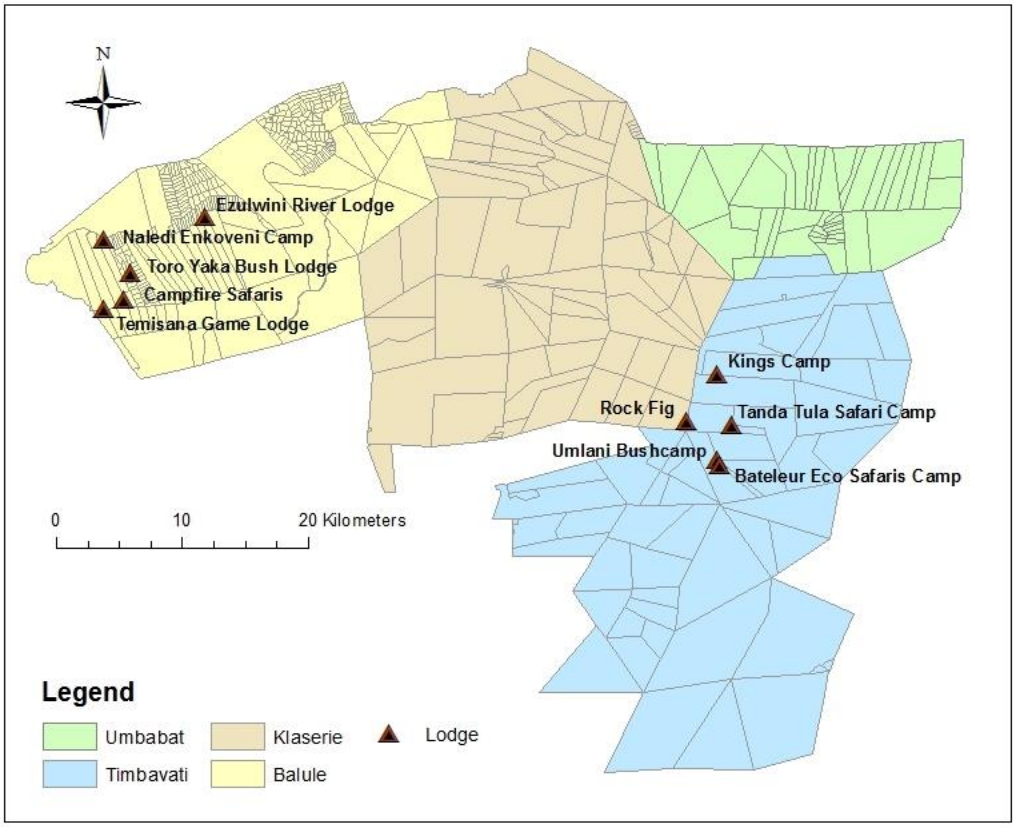

Figure 1. The Associated Private Nature Reserves (APNR) adjacent to Kruger National Park, South Africa.

2.4. Data Presentation and Analysis

ArcMap 10 was used to create the map showing the APNR boundaries and the ten lodges that participated in the distribution of survey instruments to tourists.

The attractiveness rankings and responses to the management questions were summarized as bar graphs Support for each management technique was calculated as the number of respondents who supported each management method divided by the total number of respondents within that interest group (tourists or residents). The management categories were not mutually exclusive.

For further analysis, the elephant and tree types were placed into one of four categories relating to their effects on the vegetation. The groupings refer to the

amount of elephant impact on vegetation based on information culled from the literature review (Hiscocks, 1999, Stokke & du Toit, 2000, Greyling, 2004). High impact elephants included, in order of perceived tree impact: prime bull, prime bull with collar, and elephant herd. These were the elephants known to cause high impact to trees. Low impact elephants included, in order of perceived tree impact, young bull, female, female with juvenile, and juvenile. These elephants are not known to cause high impact to trees. Highly impacted trees include marula with broken stem, debarked marula, and the open area with shrubby trees. These are trees that have been modified by elephants and are considered "damaged" by some. Non-impacted trees are those that have not been affected by elephant molestation and they include healthy marula, healthy marula with wire-netting, and the open area with large trees. The vegetation groups were selected based on the visual confirmation of the presence or absence of elephant impact. For each respondent, the attractiveness levels of the elephant and tree types were added using the format of the groups stated above and divided by the number of types in that group. This maintained the rankings on a 1-5 scale.

SPSS was used for statistical analyses with alpha set at $p < 0.05$. Independent variable t-tests were completed to identify significant differences between tourist and resident attractiveness rankings for both the elephant and tree types and to determine significant differences between the interest groups in the level of support for different elephant management methods. Analyses were also conducted testing for gender differences in the tourist and resident groups. A one-way ANOVA with a post hoc Tukey's multiple comparisons test was performed to find and examine the influence of age groups, lodge used for tourists, and residential category of respondents on their attractiveness rankings. A number of resident respondents selected more than one

category, which was not initially expected, so a random number generator was used to select a single category for each respondent.

In every possible combination, the four impact groups were tested against each other to test for a bivariate correlation using the Pearson correlation coefficient (r). Linear regression was employed to test for significant relationships for both tourists and residents.

The program R was used for the correspondence analysis of both the elephant and tree attractiveness data to look at the dispersion of individual respondents in the data space corresponding to attractiveness variables. This analysis applies to categorical data and ordinates multidimensional data from contingency tables into a 2D plot for visualizing a system of associations. This is a descriptive technique only (Phillips, 1995). Both sets of data were formatted into matrices using "dummy variables" as "on/off" switches. The selected attractiveness ranking for each elephant and tree type would receive a "1" and all other unselected rankings would receive a "0". This analysis could not be done without accounting for missing values in both data matrices, so a few methods were tried that deal with this issue. The subject deletion method was first applied, which completely deleted the subjects that had missing values in the desired data matrix. Substitution was the second method applied and it used the average of all the coordinating values to fill in the missing value space. These two methods yielded the same results, so the subject deletion method was reported.

CHAPTER 3

RESULTS

3.1 Tourist vs Resident Elephant and Tree Type Attractiveness Rankings

To test the hypothesis that tourists would give all elephant types higher attractiveness rankings compared to residents, the mean attractiveness ranking for each type was calculated for comparison purposes. There were significant differences between some interest group rankings (Table 1). Residents gave significantly higher rankings to the prime bull and the collared prime bull, while tourists had higher rankings for the elephant herd, young bull, and female with juvenile. Although there were five significant differences for elephant types, all rankings for tourists and residents were in the high range (i.e., all means were greater than 3.8 on a scale of 1.0-5.0) (Fig. 2).

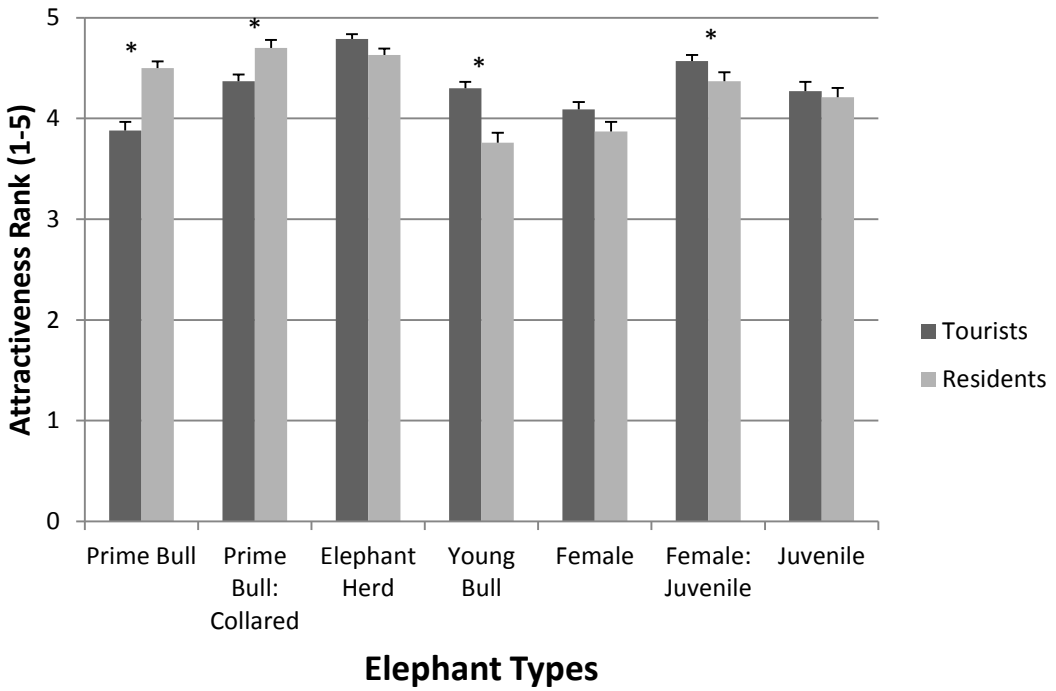

Figure 2. Average elephant type attractiveness rankings from tourist and resident surveys conducted in the APNR July-November 2012. Types are in order from those that cause the most tree impact to the least. Values are means ± 1SD

To further explain the attractiveness differences between elephant types, a correspondence analysis (Fig. 3) was used to show the distribution of all respondents and their orientation in relation to the attractiveness variables.

The variables that radiate away from the main grouping were those that correspond with low attractiveness rankings for the elephant types. Only a small number of respondents were located in the vicinity of those variables; most of the respondent points were clustered together with the high attractiveness rankings near the plot origin showing a possible outlier effect on the significant results. The outliers may have skewed the attractiveness means. These outliers did not correspond to a specific interest group.

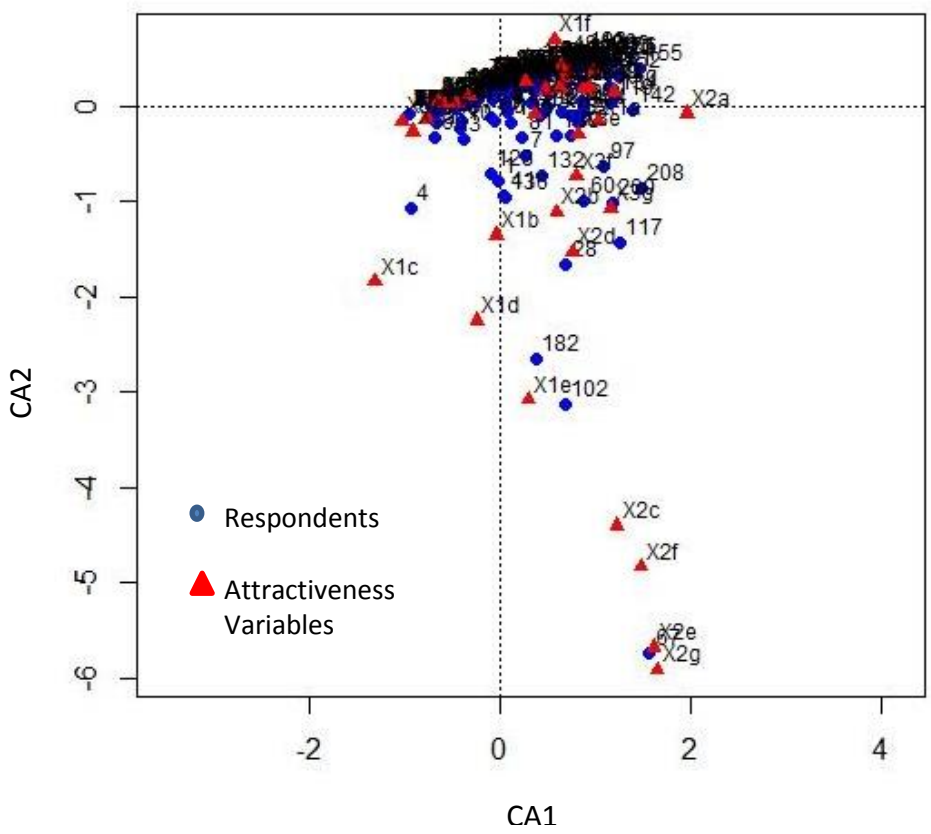

Figure 3. Correspondence analysis for elephant type attractiveness rankings showing the distribution of subjects in the data as they correspond to attractiveness variables

It was hypothesized that tourists and residents would not significantly differ in their attractiveness ratings of the various vegetation types, but there actually were significant differences with some vegetation types (Table 1). Residents had significantly higher attractiveness scores for the healthy marula, healthy marula with netting, and the open area with large trees than tourists, while this pattern was reversed for the photographs of marula with a broken stem and the mopane. There was more variation with tree type attractiveness ranking than elephant type attractiveness rankings. Through visual inspection it seemed that the impacted trees were seen as less attractive than the non-impacted trees (Fig. 4).

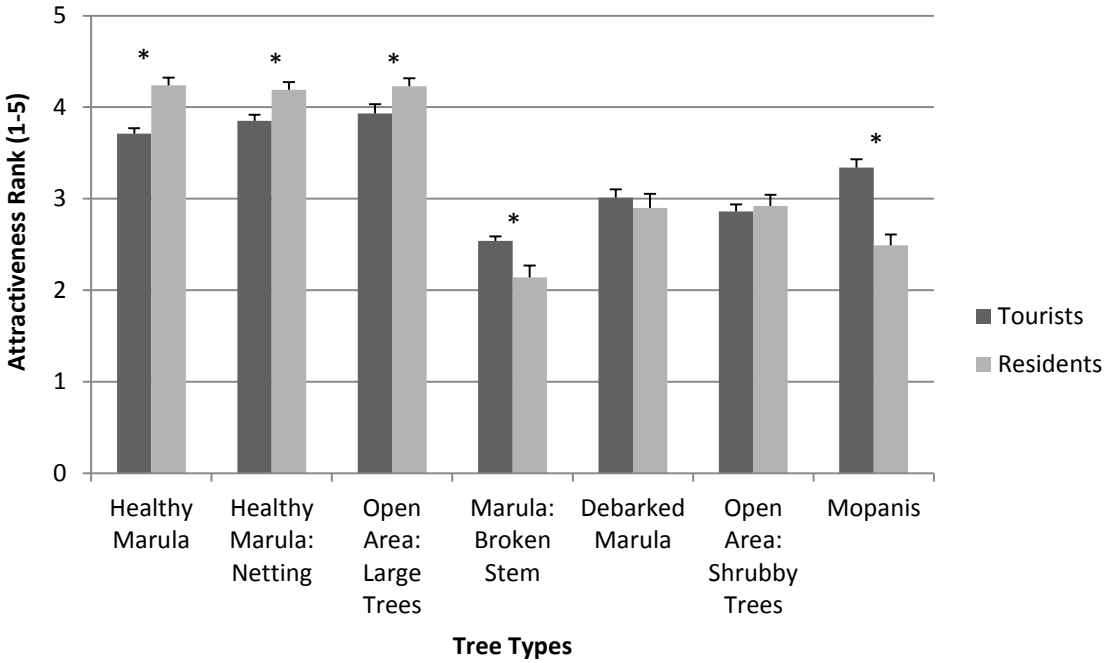

Figure 4. Average tree type attractiveness rankings from tourist and resident surveys conducted in the APNR July-November 2012. Types are in order from those associated with no elephant impact to those with impact. Mopane are not used in the impact category.

The correspondence analysis was used to further explain the tree type attractiveness variation (Fig. 5). The variables stretching to the top of the plot were for low attractiveness and the variables stretching to the left were high attractiveness rankings. This dispersion showed that there were distinct differences between a group of tree types ranked highly attractive and a group of tree types ranked lower in attractiveness.

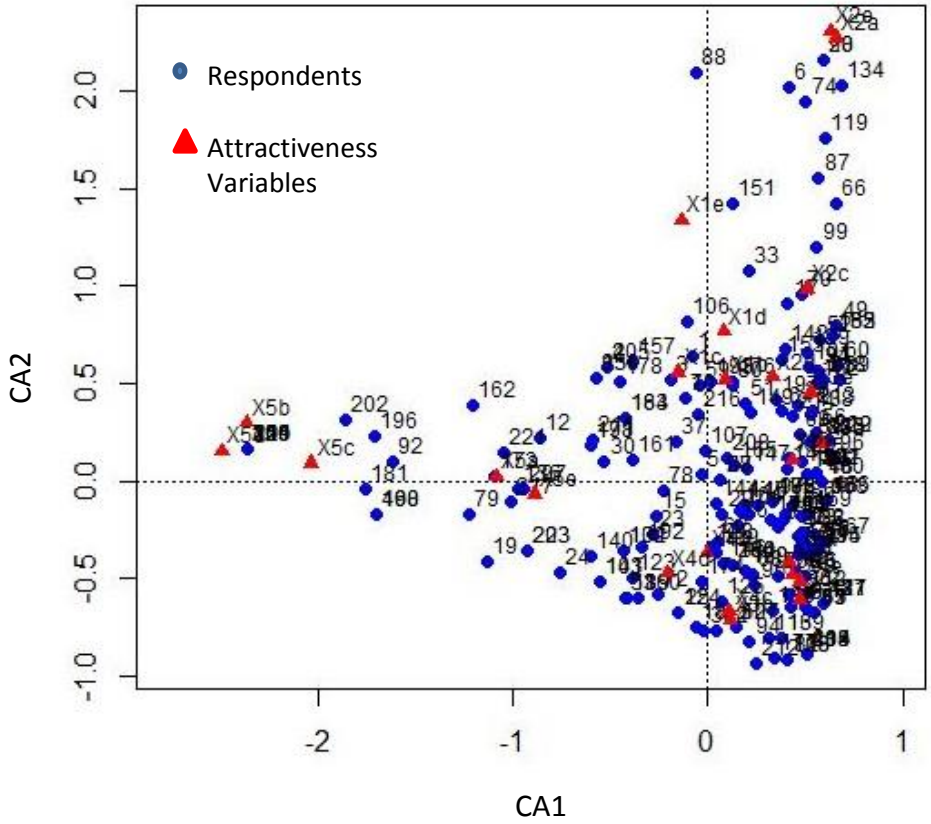

Figure 5. Correspondence analysis for vegetation type attractiveness rankings showing the distribution of subjects in the data as they correspond to an attractiveness variable

Table 1. Independent sample t-test statistics comparing elephant and tree type attractiveness ranks between tourists and residents

	Tourist		**Resident**				
Elephant Type	Mean	SD	Mean	SD	t	df	Sig. 2-tailed
Young Bull	4.30	0.755	3.76	0.883	4.715	149.038	0.000
Prime Bull	3.88	1.031	4.50	0.593	-5.704	220.985	0.000
Female	4.09	0.858	3.87	0.857	1.841	221.000	0.670
Juvenile	4.27	1.088	4.21	0.842	0.476	203.569	0.634
Female with Juvenile	4.57	0.719	4.37	0.794	2.009	221.000	0.046
Prime Bull collared	4.37	0.790	4.70	0.715	-3.132	183.561	0.002
Elephant Herd	4.79	0.567	4.63	0.580	2.054	163.849	0.042
Tree Type	Mean	SD	Mean	SD	t	df	Sig. 2-tailed
Healthy Marula	3.71	1.079	4.24	0.75	-4.297	213.959	0.000
Healthy Marula: netting	3.85	0.941	4.19	0.756	-2.816	222	0.005
Marula: broken stem	2.54	1.216	2.14	1.191	2.362	222	0.019
Debarked Marula	3.01	1.079	2.9	1.402	0.619	139.58	0.510
Open area: shrubby trees	2.86	1.043	2.92	1.118	-0.394	221	0.694
Open area: large trees	3.93	0.949	4.23	0.801	-2.316	221	0.016
Mopane trees	3.34	1.072	2.49	1.091	5.499	196	0.000

3.2 Comparisons of Special Interest

There were certain concerns of interest that pertained to the tourism economy. Elephants with a collar may be seen as less attractive than elephants without a collar by tourists as it is not natural. Perception of these collars is important both for

elephant researchers as well as lodge managers. When comparing the mean attractiveness scores between the prime bull collared and the non-collared bull within groups, tourists and residents both found the collared bull to be more attractive than the non-collared bull (Table 2). This falsifies the hypothesis; neither interest group perceived the collared prime bull as less attractive than the non-collared prime bull.

For the same reason, trees with wire-netting might were less attractive than trees without netting. This difference was tested by comparing the healthy marula with the healthy marula with netting amounting to a non-significant result for both tourists and residents (Table 2).

Table 2. Independent sample t-test statistics comparing interest group attractiveness rankings of prime bull: collared vs. prime bull and healthy marula vs. healthy marula: wire-netting

Tourist	Mean	SD	t	df	Sig. 2-tailed
Prime Bull Collared	3.89	1.023	-4.060	280	0.000
Prime Bull	4.37	0.790			
Healthy Marula	3.71	1.079	-1.180	280	0.136
Healthy Marula: wire-netting	3.85	0.941			

Resident	Mean	SD	t	df	Sig. 2-tailed
Prime Bull Collared	4.50	0.593	-1.500	164	0.000
Prime Bull	4.70	0.715			
Healthy Marula	4.24	0.75	-0.050	164	0.960
Healthy Marula: wire-netting	4.20	0.761			

Despite the somewhat scrubby appearance of mopane thickets, tourists ranked the photograph depicting a mopane thicket significantly higher in attractiveness than residents with an average score of 3.34 ± 0.10SE (Independent Sample T-test, t = 5.499, 196 df, P<0.001). While this is not a high ranking, it is still indicates the mopane thicket in the photograph was considered somewhat attractive compared to the resident score of 2.49 ± 0.12SE.

3.3 Demographic Effects on Attractiveness Perceptions

The demographics for age, gender, lodge used, and resident category were examined as independent variables for attractiveness rankings of elephant and tree types. Looking at the whole pool of respondents, including both interest groups, significant differences were found between males (n = 134) and females (n = 88) for some of the elephant and tree types. Females had a tendency to rank elephants that have relatively low vegetation impact on tree higher than males including; young bull (Ind. sample t-test, t = -4.094, 217 df, P < 0.001), female (Ind. sample t-test, t = -2.957, 217 df, P = 0.003), juvenile (Ind. sample t-test, t = -2.275, 217 df, P = 0.024), and female with juvenile (Ind. sample t-test, t = -3.132, 190.717 df, P = 0.002) Significant differences were not evident between the gender respondents with the rankings of all other elephant types.

When analyzing tourists and residents as separate groups, slight variations were found for the paragraphs discussed above. Resident females (n = 13) found the juvenile (Ind. sample t-test, t = -2.182, 78 df, P = 0.032) and female with juvenile (Ind. sample t-test, t = -3.360, 25.949 df, P = 0.002) elephant types more attractive

than resident males (n = 70). Female tourists (n = 65) scored photographs of the young bull (Ind. sample t-test, t = -2.016, 137 df, P = 0.046) and adult female elephant (Ind. sample t-test, t = -2.167, 119. 35 df, P = 0.032) significantly more attractive than did male tourists (n = 75).

For all respondents, including both tourists and residents, males had higher attractiveness rankings for the healthy marula (Ind. sample t-test, t = 2.140, 217 df, P = 0.033) and the healthy marula with netting (Ind. sample t-test, t = 2.350, 218 df, P = 0.020) than females, but females rated mopane (Ind. sample t-test, t = -3.526, 193 df, P = 0.001) as more attractive than did males. Significant differences between genders were not found when analyzing tourists and residents separately for vegetation types.

Age group of respondents (four groups: (1) 18-30 y, (2) 31-50 y, (3) 51-70 y, and (4) > 70 y (Table 3) was not an informative variable for discriminating attractiveness scores of the photographs for elephants or vegetation. The only significant difference in the elephant attractiveness scores by age group was that group 1 found the prime bull to be significantly less attractive than group 3 (Tukey, P = 0.021). Group 1 found the healthy marula to be significantly less attractive than group 3 (Tukey, P = 0.038). Group 1 also found the healthy marula with wire-netting to be less attractive than age group 2 (Tukey, P = 0.48) and group 3 (Tukey, P = 0.038). The last difference found was that group 1 found the marula with a broken stem more attractive than group 4 (Tukey, P = 0.002).

Table 3. Sample sizes of each age group in regards to sex of respondents

Age Group		Male	Female	Total
1	18-30y	13	19	32
2	31-50y	37	22	59
3	51-70y	58	37	95
4	>70y	21	7	28
Total		129	85	214

The residential categories also had a minimal amount of significant attractiveness ranking differences between them, giving this variable a weak effect on perception. Residents fitting the category of landowner found the young bull to be significantly more attractive than shareholders (Tukey, 81df, P = 0.020). Landowners also found the female (Tukey, 81df, P = 0.001) and the female with a juvenile (Tukey, 81df, P = 0.027) to be more attractive than wardens.

The lodging selection of tourists was an additionally uninformative variable with only one statistical difference. Tourists staying at Tanda Tula found the marula with a broken stem to be significantly less attractive than tourists lodging at Toro Yaka (Tukey, 140df, P = 0.001) and Rock Fig (Tukey, 140df, P = 0.002).

3.4 Past Experience Effects on Attractiveness Perceptions

The background experiences with elephants and trees were hypothesized to influence the attractiveness ratings by respondents. I In general, past experiences had little influence on attractiveness ratings with no obvious trends evident. Only 12 of the 70 independent t-tests completed were significant (see Appendix D).

Analyzing the interest groups separately was a bit more informative. Tourists that had close encounters with elephants, observed trees impacted by elephants, and witnessed groups of animals other than elephants gathered around trees ranked the open area with shrubby trees lower than those who did not had those experiences. Only 3 of the 70 independent t-tests completed were significant, but the differences created a noticeable trend (see Appendix D).

The attractiveness ratings by residents were not analyzed in this case as residents more frequently had experiences with elephants resulting in very little variation in how they answered these particular questions. This lead to very unequal sample sizes which could not be tested statistically.

3.5 Attractiveness Rankings with Elephant Impact Implications

The mean attractiveness rankings were calculated for elephants that have a high impact on trees, elephants that have a low impact on trees, highly impacted trees, and non-impacted trees (Fig. 6). Residents were predicted to have higher attractiveness scores for the low impact elephants and lower scores for the high impact elephants compared to tourists. In fact, residents gave significantly higher rankings to high impact elephants (Ind. sample t-test, $t = -3.628$, 204.858df, $P < 0.001$) compared to tourists. Tourists gave significantly higher rankings to low impact elephants (Ind. sample t-test, $t = 2.933$, 221df, $P = 0.004$) than residents who ranked high impact elephants significantly higher than low impact elephants (Ind. sample t-test, $t = 5.936$ 162df, $P < 0.001$), while there was no statistical difference for tourists. All elephant types still received high rankings from both interest groups (all means > 4.0 out of a maximum score of 5).

My hypothesis supported that tourists and residents would not differ in their attractiveness ratings of highly impacted trees (Stats). However, residents ranked non-impacted trees higher in attractiveness than did tourists (Ind. Sample t-test, t = -3.936, 200.984df, P<0.001). I also hypothesized that non-impacted trees would be viewed as more attractive than highly impacted trees. This hypothesis was supported for both tourists (Ind. sample t-test, t = -10.010, 280df, P < 0.001) and residents (Ind. sample t-test, t = -12.800, 164df, P < 0.001).

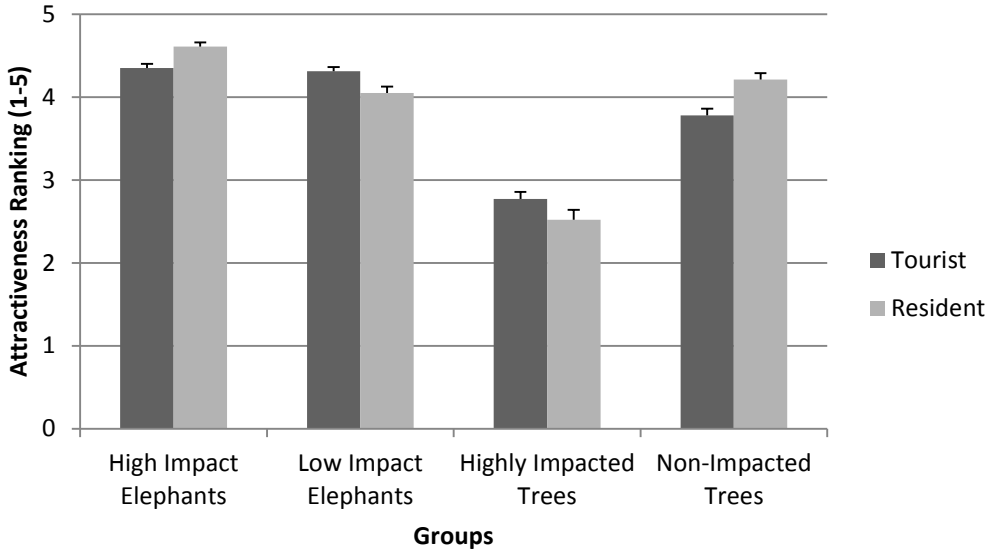

Figure 6. Mean attractiveness rankings for the impact groups as individual elephant and tree types were assembled together based on the associated amount of tree impact caused and the amount of elephant impact received.

I made several hypotheses on the correlations between the ratings of elephant types and tree types. First, both tourist (Pearson correlation coefficient, $r_p = 0.250$, P < 0.001) and resident (Pearson correlation coefficient, $r_p = 0.397$, P < 0.001) rankings had moderate significantly positive correlations between the attractiveness levels of the high impact elephant group and the non-impacted tree group (Figure 7). Second, as high impact elephant attractiveness increased so did the highly impacted tree attractiveness (Fig. 8). This was true for both tourists (Pearson correlation coefficient,

$r_p = 0.299$, $P < 0.001$) and residents (Pearson correlation coefficient, $r_p = 0.284$, $P = 0.010$). The significantly positive correlations were moderate.

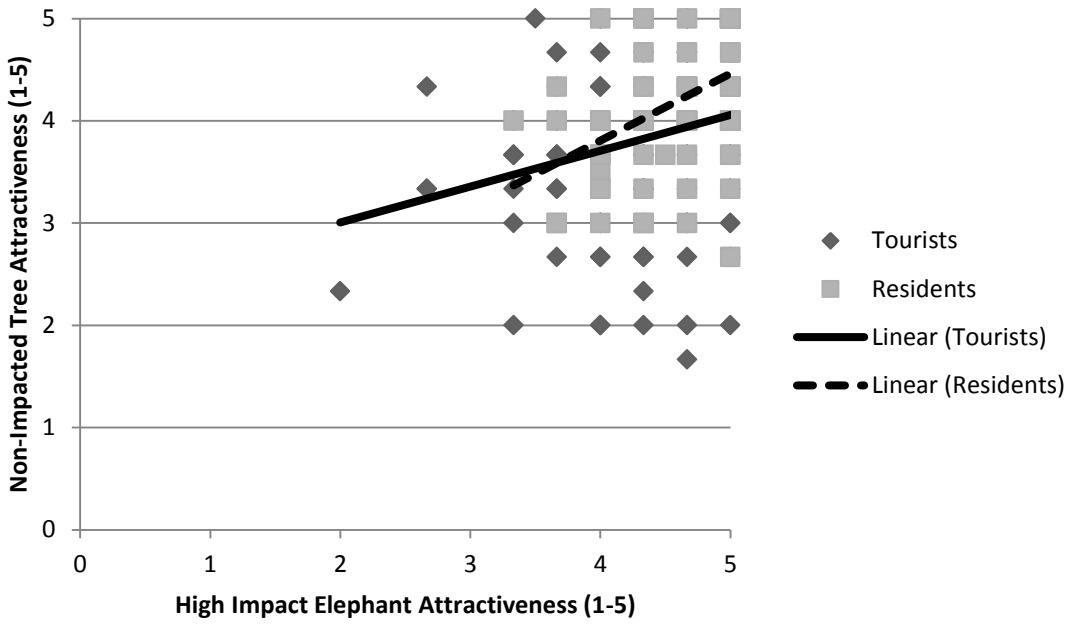

Figure 7. Plot comparing the high impact elephant group attractiveness to that of the non-impacted tree group for tourists and residents.

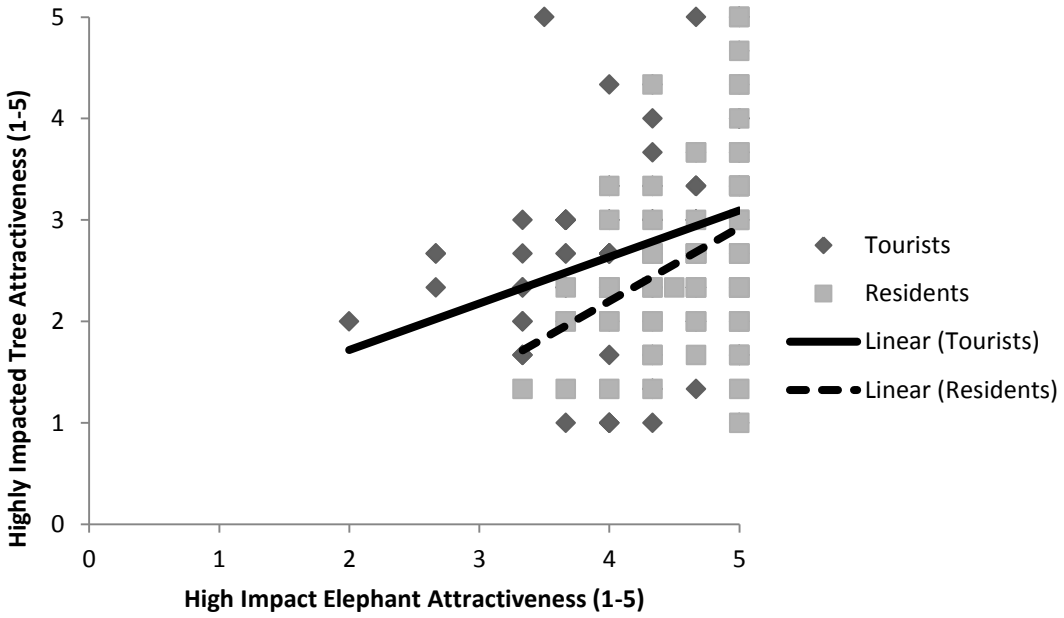

Figure 8. Plot comparing the high impact elephant group attractiveness levels to that of the highly impacted tree group for residents and tourists.

Unlike the previous hypotheses the correlation was thought to be negative. Third, in contrast to the expected negative correlation, the relationship between low impact elephants and highly impact trees was moderately positive for both tourists (Pearson correlation coefficient, $r_p = 0.252$, $P = 0.004$) and residents (Pearson correlation coefficient, $r_p = 0.336$, $P = 0.002$). Fourth, the correlation between high impact elephants and non-impacted trees with tourists (Pearson: 0.250, $P < 0.001$) and residents (Pearson: 0.397, $P < 0.001$) were each moderately positive These latter two correlations indicate a conflict in human perception.

3.6 Support of Research, Elephant Management Methods, & Economic Tree Use

The perceptions of tourists and residents on research were examined through questions about the efforts of researchers to reduce the elephant impact on large trees. Both tourists and residents were found to appreciate these efforts (Fig. 9).

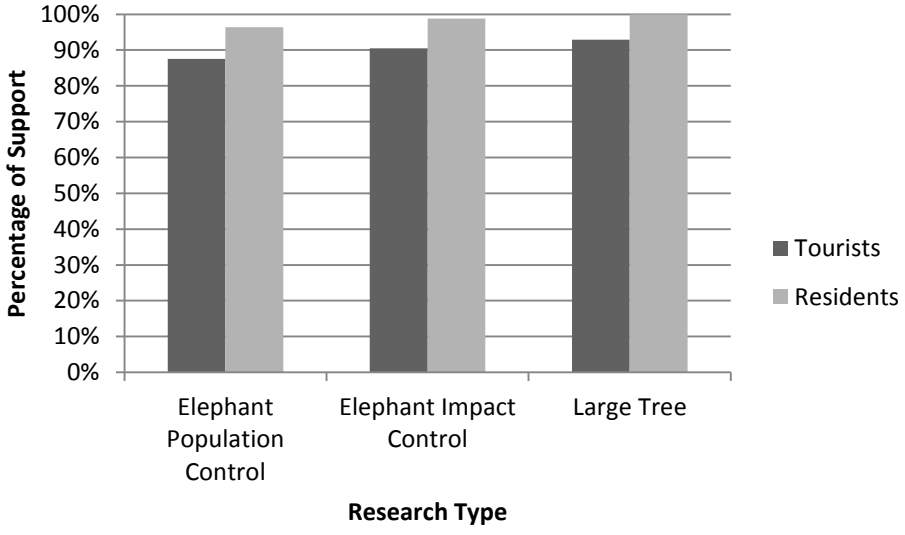

Figure 9. Percentage of support by each interest group for different types of research pertaining to the current study

I hypothesized that tourists would have higher support for the non-intrusive elephant management methods such as no interference and environmental

manipulation and residents would have higher support for the intrusive methods of translocation, contraception, and culling. These hypotheses were upheld (Fig. 10). Tourists had significantly higher support for the non-intrusive method of no interference while residents had significantly higher support for environmental manipulation and the intrusive methods of translocation and culling. There was not a difference in support for contraception (Table 2). The largest differences can be seen with the no interference and culling methods which are at opposite ends of the intrusion spectrum.

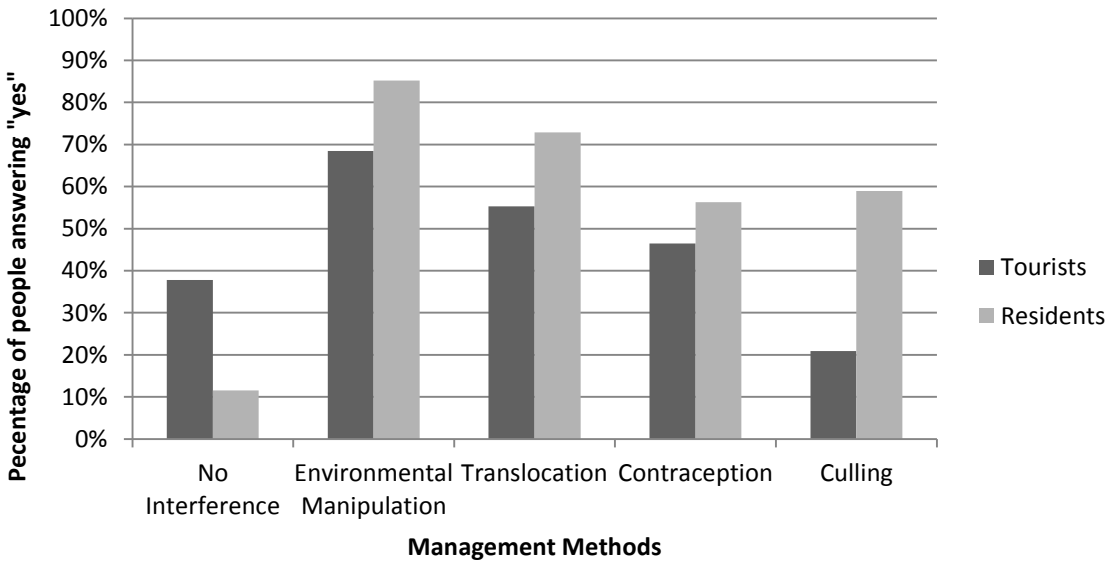

Figure 10. Percentage of support by each interest group for the five elephant management methods

Table 4. Independent Sample t –test comparing elephant management method support between tourists and residents.

	Tourists		**Residents**				
Elephant Management Methods	Mean	SD	Mean	SD	t	df	Sig. 2-tailed
No interference	0.38	0.487	0.12	0.322	4.648	201.886	0.000
Environmental manipulation	0.68	0.466	0.85	0.357	-2.933	200.115	0.004
Translocation	0.55	0.499	0.73	0.448	-2.656	183.440	0.009
Contraception	0.46	0.501	0.56	0.499	-1.372	205.000	0.172
Culling	0.21	0.408	0.59	0.495	-5.713	139.224	0.000

The hypothesis that tourists would have a higher support for the cutting of trees for economic purposes than residents also was supported. Tourists had significantly higher support for the cutting of native trees for firewood ($P < 0.001$) and for use as building materials ($P < 0.001$). There was not a difference in the support for the cutting of trees for agricultural purposes. All three economic purposes had < 35% support by both interest groups showing very low support for the cutting of native trees outside of protected areas.

CHAPTER 4

DISCUSSION

Tourists and residents found all elephant types appealing, scoring all photographs highly. Statistically significant differences between the tourist and resident rankings of certain elephant types were found but those results do not seem as telling when looking at the distribution of subjects in the data space. Not much differentiability was seen between respondents, and the fact that most of the respondent points clustered together around the high attractiveness ranking variables shows the generalization of high ranks for all elephant types. Due to this, interest groups may not be associating their attractiveness levels with the different amounts of tree impact each elephant type potentially causes.

The significant difference that does draw attention is the one between the prime bull and the prime bull with a collar. Lodge managers and residents may potentially be concerned that the collars on elephants used by researchers were not attractive for the guests at lodges. Seeing collars on elephants may dissuade tourists from coming to that area to view elephants. The survey showed this to not be true as both residents and tourists gave the prime bull with a collar a significantly higher attractiveness ranking than the prime bull without a collar. The picture selection may have affected this ranking as the prime bull with a collar may seem more impressive than the other as it is hard to eliminate bias in photos, but it still remains that the collar did not seem to be a negative factor when ranking.

Due to the results, interest group seems to be the main variable influencing elephant and tree type attractiveness. Age, lodge used, and resident category had very few significant differences between groups describing themselves as unlikely causation variables. Gender provides insightful information as women had a higher attractiveness to low impact elephants than men, even though men ranked the impact group in the high range. Women may just like what would be considered "cute" elephants including mid to small sized elephant types pictured in the questionnaire.

Patterns associated with tree type attractiveness and management methods might be explained by the experience of the residents with their property or management area and their concern for that expanse of land as part of their livelihood. This may be causing residents to have an extra personal connection to the healthy trees of the area as they increase landscape aesthetics (Barretto, 2013). This dependence on an aesthetic carrying capacity may also be influencing resident support for more intrusive elephant management methods. Residents represent the interest group living with the situation of elephants impacting trees, and they may want to see the elephants controlled more aggressively to protect their property from impact.

The variation in the vegetation type data space supports this notion. Even though tourists ranked the healthy marula, healthy marula with wire-netting, and the open area with large trees with high attractiveness levels, residents had significantly higher attractiveness ranks for those types. These are all vegetation types associated with low elephant impact, which would be the most desired by residents. Tourists had significantly higher attractiveness levels for the marula with the broken stem and the mopane. This is easily conceived as residents would have a more conceptual reason to think the marula with the broken stem as unattractive.

Different elephant experiences may have an effect on the tourist idea of certain vegetation types. Tourists who have witnessed elephants impacting trees or gathered around them may have linked such experiences with the possibility of landscapes becoming shrubby and devoid of large trees, which they did not prefer compared to other vegetation types.

Lodge owners and managers expressed concern about the mopane not being one of those preferred types because mopane often grows in large, mono-specific stands to the exclusion of other plant species (Smit & Rethman, 2000). This habitat type is therefore often associated with only particular herbivore species, and the low overall species diversity may not appeal to tourists. The difference in mopane attractiveness levels provides good insight into the lodge owners' concerned assumption stating that tourists will consider mopane as unappealing. The tourists had a moderate attractiveness towards mopane giving opposing support to the belief of lodge owners; this ranking was higher than expected as residents found them unattractive due to the reasons mentioned previously. Tourists do not seem to have an opinion favored for one end of the spectrum or the other; therefore the management efforts to remove mopane may not be essential for tourism.

Although, finding the best elephant management technique is essential. Tourists had higher support for the non-intrusive method of no interference while residents had higher support for the intrusive methods not including contraception. Part of the reason tourists visit the area is to view the wildlife (Lindsey, Alexander, Mills, Romanach, & Woodroffe, 2009) and they may not enjoy seeing the elephants antagonistically managed. Tourists are probably not as familiar with the impact of elephants on trees; thus they do not see the need for aggressive management.

Even with this unfamiliarity, tourists still have an appreciation for a functional ecosystem and not just the individual components. Their moderate attraction for mopane and their high attraction to both collared elephants and wired trees support this conclusion. Even though tourists prefer the most natural management methods, they are open to human manipulation as long as elephants are not negatively affected in the process. Elephants can no-longer be managed strictly by nature as humans have forced them into an unnatural situation of more confined spaces (Woolley, Mackey, Page, & Slotow, 2008).

Choosing a management method is now an ethical question that includes all of those involved (Decker & Eack, 1996). In this situation, environmental manipulation such as the removal or addition of a waterhole seems to be the best balance between tourists and residents as it is not physically intrusive to the elephant and it helps to control the population numbers in the area (Chamaillé-Jammes, Valeix, & Fritz, 2007). This method received the highest support from both interest groups. The Conservation Ecology Research Unit (2012) stated that the distribution of water sources in the area influences the use of habitat by elephants as they are heavily reliant on drinking water. If a water hole is removed, then it dissuades elephants from spending an extended period of time in that area, ultimately lessening the impact on that habitat zone. This method obviously does not have the instant impact of culling, but it is more ethical and perpetually effective.

Other management methods have their disadvantages. No interference is not a realistic option as humans have already interfered (van Aarde, Jackson, and Ferreira, 2006). The translocation method is very expensive and probably not in the budget of many management directives (Schulman, 2006). Contraception can control the birth rate of a specific breeding herd, especially within small reserves, but it does not stop

elephants from feeding (van Aarde, Jackson, and Ferreira, 2006). The tree impact may not necessarily be reduced just because a population's birth rate is decreased. Culling is a method of great ethical debate and its effectiveness comes into question (Dickson & Adams, 2009). Culling an elephant population actually counteracts its own purpose as it decreases population densities to a level of optimal reproduction. When reaching the upper tier population density levels that make culling seem rational, populations would naturally decline just as effectively (van Aarde, Whyte, and Pimm, 1999). Due to perceptual implications and the logistics of tree impact control effectiveness, environmental manipulation should be a primary management option.

The difficulties of management can be attested to tourists and residents scoring pictures of healthy trees and elephants as highly attractive. This indicates a conflict of interest. Managers are left with the option to decide which elephant types they should attempt to keep in a sensitive area and which types they should not, or alternatively, they need to devise methods to protect individual trees which are attractive to tourists and residents alike. A cause-and-effect connection between human perceptions of elephants and tree damage is not supported as evidenced by the conflicting correlations amongst the elephant and tree impact groups. Thus, the best decision is not always obvious.

Nevertheless, the equivalence of elephant attractiveness scores compared to the large attractiveness difference between non-impacted trees and impacted trees creates a premise for a suggested management plan. The balanced high attractiveness scores of elephants means that low impact elephants should keep tourists and residents just as satisfied as high impact elephants. Interest groups did not display a bias towards one type or another as they did with tree types. Structurally intact trees appear to be perceived as highly attractive and valuable based on the very low support

for the cutting of trees for humanistic purposes; therefore, trees may need to be the primary management target.

The human perception results of this study support the technique known as meta-population management where you focus more on the environmental impact than the actual population of elephants as the type of environment can dictate the numbers in a population (van Aarde & Jackson, 2007). This is a technique that does not provide instantaneous results that are so often expected by residents, but it should create more natural and sustainable results. By manipulating elephant numbers there is no assurance that the impacted trees will recover (Owen-Smith et al., 2006). Meta-population management directly manages the impact on the trees instead of indirectly managing the issue through that of the accused "problem" elephants (Conservation, 2012).

Knowledge of these social concerns facilitates management plans that are satisfactory to all interests, including the preservation of the environment (Treves, Wallace, Naughton-Treves, & Morales, 2006) and the success of the tourism economy as pertaining to this study (Ballantyne, Packer, & Sutherland, 2011). Before land management policies are instituted, officials in charge of environmental regulations are increasingly seeking to understand public perception, not only for consultation but also to augment the education of the public on human-wildlife conflict (White et al., 2005). Other surveys have shown that people express concern about the environment, but only rarely do they act on these concerns (Kaiser, Ranney, Hartig & Bowler, 1999). The information provided by this study gives managers a chance to understand the perception of the groups involved and act in accordance to either an ecological or economical focus.

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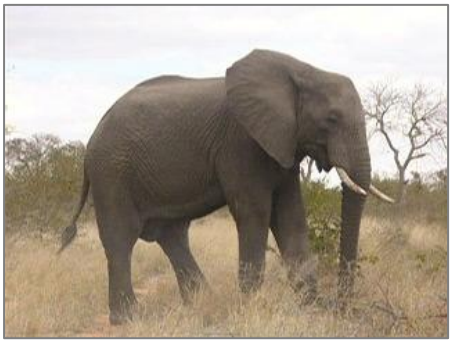
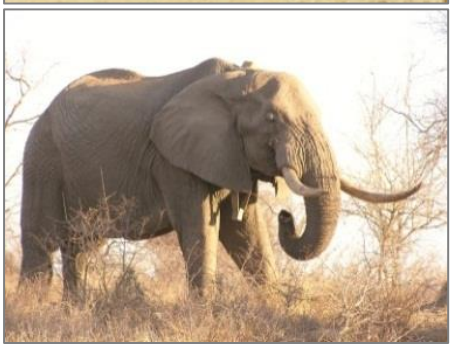
APPENDIX A

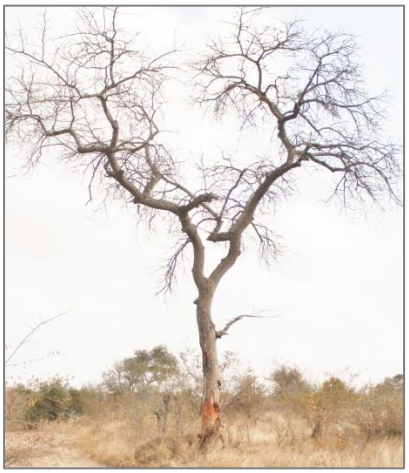
HUMAN PERCEPTION OF ELEPHANT AND TREE TYPES
ATTRACTIVENESS QUESTIONNAIRE

DIRECTIONS: We are interested in knowing the perceptions people have toward elephants in South Africa. Please examine each picture below. Then, please circle your level of attractiveness toward each type of elephant ranging from very low (1); low (2); average (3); high (4); very high (5).





DIRECTIONS: We are also interested in knowing the perceptions people have toward landscapes and trees in South Africa. Please examine each picture below. Then, please circle your level of attractiveness toward each type of tree ranging from very low (1); low (2); average (3); high (4); very high (5).



DIRECTIONS: Please circle yes or no for each of the questions asked below.

1. Have you ever observed elephant impact on trees?
2. Have you had close encounters with elephants?
3. Does the presence of elephants intimidate you?
4. Have you seen groups of elephants gathered around large trees?
5. Have you seen groups of other animals gathered around large trees?
6. Do you support elephant population control research?
7. Do you support elephant impact control research?
8. Do you support research on large trees?

DIRECTIONS: Please indicate which of the following measures you support in order to manage elephants in South Africa. (Yes or No)

9. No interference
10. Manipulate the environment to restore more natural processes to relieve localized elephant impact (e.g. closure of excess waterholes)
11. Translocation (capturing and moving) of elephants
12. Contraception of elephants
13. Culling (non-selective killing) of elephants

DIRECTIONS: For economic purposes, do you support the cutting of large native trees outside of protected areas? (Yes or No)

14. For firewood (fuel)
15. For use as building materials
16. For Agriculture (to clear land)

Tourist Modified Questions

17. What is your country of origin? (please write)
18. How many times a year do you travel outside of your home country? (please write number)
19. How many times have you visited South Africa if non-resident? (please write number)
20. What is your preferred language? (please write)
21. What is the name of lodge/property where you are staying in South Africa (please write)
22. What is the year of your birth? (please write year)
23. What is your gender? (please circle male or female)

Resident Modified Questions

17. In which country were you born? (please type)
18. How many years have you been a resident of South Africa? (please type number)
19. What is the year of your birth? (please type)
20. What is your gender? (please choose male or female)
21. Which category most accurately describes you?
    a. Landowner
    b. Shareholder
    c. Warden
    d. Field Guide
    e. Other

APPENDIX B

RESPONDENT BACKGROUND INFORMATION SAMPLE SIZES

	All		Tourists		Residents	
Had Experience	Yes	No	Yes	No	Yes	No
Observed elephant impact on trees	198	26	116	25	82	1
Had close encounters with elephants	198	26	117	24	81	2
Is presence of elephants intimidating	46	176	37	102	9	74
Observed groups of elephants around large trees	165	58	86	54	79	4
Observed groups of other animals around large trees	185	39	104	37	81	2
Support						
Elephant population control research	199	20	119	17	80	3
Elephant impact control research	206	14	124	13	82	1
Research on large trees	214	10	131	10	83	0
No interference	57	148	48	79	9	69
Environmental manipulation	158	53	89	41	69	12
Translocation	132	81	73	59	59	22
Contraception	104	103	59	68	45	35
Culling	73	134	27	102	46	32
Cutting trees for firewood	35	179	34	98	1	81
Cutting trees for building material	53	162	44	88	9	74
Cutting trees for agriculture	49	168	34	100	15	68

APENDIX C

TOURIST LODGE SAMPLE SIZES

Lodges	Male	Female	N/A	Total
BPNR				
Campfire Safaris	4	7	0	11
Ezulwini River Lodge	1	1	0	2
Naledi Enkoveni	0	0	0	0
Toro Yaka	4	3	0	7
Tremisana	6	3	0	9
TPNR				
Bateleur Eco Safaris	5	9	0	14
Kings Camp	0	3	1	4
Rock Fig	18	12	0	30
Tanda Tula Safari Camp	24	29	0	53
Umlani Bushcamp	2	8	1	11
Total	64	75	2	141

APPENDIX D

PAST EXPERIENCE EFFECT ON ELEPHANT AND TREE TYPE PERCEPTIONS

The tables below show the significant differences in attractiveness of elephants and tree types based on whether respondents answered yes or no to having the experience.

Includes all respondents:

Experience	Elephant/tree Type	t	df	Sig 2-tailed	Attractiveness Means	
					Yes	No
Seen elephants impact trees	Open Area: Shrubby Trees	-2.599	221	0.010	2.81	3.38
	Mopane	-2.417	196	0.017	2.92	3.55
Had close encounters with elephants	Marula: Broken Stem	-2.031	222	0.043	2.33	2.85
	Open Area: Shrubby Trees	-1.994	221	0.047	2.83	3.27
Presence of elephants intimidating	Prime Bull	-2.522	219	0.012	3.80	4.19
Groups of elephants gathered around large trees	Prime Bull	2.381	220	0.018	4.20	3.86
	Prime Bull: Collared	2.365	219	0.019	4.56	4.28
	Healthy Marula	3.128	220	0.002	4.02	3.55
	Healthy Marula: netting	2.151	221	0.033	4.05	3.76
Groups of other animals gathered around large trees	Prime Bull: Collared	1.998	220	0.047	4.54	4.26
	Open Area: Shrubby Trees	2.460	221	0.015	2.80	3.26
	Mopane	-2.909	196	0.004	2.88	3.52

Includes tourists:

Experience	Elephant/tree Type	t	df	Sig 2-tailed	Attractiveness Means	
					Yes	No
Seen elephants impact trees	Open Area: Shrubby Trees	-3.183	138	0.002	2.73	3.44
Had close encounters with elephants	Open Area: Shrubby Trees	-2.504	138	0.013	2.76	3.33
Presence of elephants intimidating	None					
Groups of elephants gathered around large trees	None					
Groups of other animals gathered around large trees	Open Area: Shrubby Trees	-3.084	138	0.002	2.70	3.31

APPENDIX E

RESEARCH PARTICIPANT CONSENT FORM

Elephant and Large Tree Research

Informed Consent:

We appreciate your time and effort in completing this short survey. This research is being conducted by researchers affiliated with the Department of Biology at Western Kentucky University in the United States and the non-governmental organization Save the Elephants - South Africa. The results gained from this research may be put towards conservation and management efforts for elephants and large trees.

Please know that your participation is voluntary and you may stop completing this survey instrument at any time, and if you are under the age of 18 years old, please do not complete this survey. We are making every effort to protect your privacy and anonymity. Please do not put your name or contact information on this survey instrument.

Completing this questionnaire should take no more than 10 minutes. Thank you again for your time and efforts. Your continued cooperation implies your consent.

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THE DATED APPROVAL ON THIS CONSENT FORM INDICATES THAT
THIS PROJECT HAS BEEN REVIEWED AND APPROVED BY
THE WESTERN KENTUCKY UNIVERSITY INSTITUTIONAL REVIEW BOARD
Paul Mooney, Human Protections Administrator
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WKU IRB# 12-301
Approved - 8/16/2012
End Date - 12/31/2012
Expedited
Original - 5/30/2012